

CLAIMS:

What is claimed is:

1. A method of treating a dielectric film comprising:  
exposing at least one surface of said dielectric film to a  $C_xH_y$  containing material, wherein:  
 $x$  and  $y$  are each integers greater than or equal to a value of unity, and said dielectric film has a dielectric constant value less than the dielectric constant of  $SiO_2$ .
2. The method of claim 1, further comprising:  
exposing said at least one surface of said dielectric film to at least one of a nitrogen containing material and a chlorine containing material.
3. The method of claim 1, wherein said exposing said dielectric film comprises exposing a dielectric film having a dielectric constant ranging from 1.6 to 2.7.
4. The method of claim 1, wherein said exposing said dielectric film comprises exposing at least one of a porous dielectric film, and a non-porous dielectric film.
5. The method of claim 1, wherein said exposing said porous dielectric film comprises exposing at least one of a single-phase material, and a dual-phase material.
6. The method of claim 1, wherein said exposing said dielectric film comprises exposing a film including at least one of an organic material, and an inorganic material.
7. The method of claim 6, wherein said exposing a film comprises exposing a film including an inorganic-organic hybrid material.

8. The method of claim 6, wherein said exposing a film comprises exposing a film including an oxidized organo silane.

9. The method of claim 6, wherein said exposing a film comprises exposing a film including at least one of hydrogen silsesquioxane, and methyl silsesquioxane.

10. The method of claim 6, wherein said exposing a film comprises exposing a film including a silicate-based material.

11. The method of claim 6, wherein said exposing a film comprises exposing a collective film including silicon, carbon, and oxygen.

12. The method of claim 11, wherein said exposing a collective film further comprises exposing hydrogen in said collective film.

13. The method of claim 1, wherein said exposing said dielectric film to said  $C_xH_y$  containing material comprises introducing said  $C_xH_y$  containing material in at least one of vapor phase, liquid phase, and within a supercritical fluid.

14. The method of claim 13, wherein said introducing said  $C_xH_y$  containing material within said supercritical fluid comprises introducing said  $C_xH_y$  containing material within supercritical carbon dioxide.

15. The method of claims 1 or 2, wherein said exposing said dielectric film to said  $C_xH_y$  containing material comprises exposing said dielectric film to at least one of a  $CH_2$  containing material, and a  $CH_3$  containing material.

16. The method of claim 1, wherein said exposing said dielectric film to said  $C_xH_y$  containing material comprises exposing said dielectric film to at least one of TMCTS, and OMCTS.

17. The method of claim 2, wherein said exposing said dielectric film to said C<sub>x</sub>H<sub>y</sub> containing material comprises exposing said dielectric film to at least one of hexamethyldisilazane (HMDS), trimethyldisilazane (TMDS), chlorotrimethylsilane (TMCS), trichloromethylsilane (TCMS), [C<sub>6</sub>H<sub>5</sub>Si(CH<sub>3</sub>)<sub>2</sub>]<sub>2</sub>NH, C<sub>15</sub>H<sub>29</sub>NSi, (CH<sub>3</sub>)<sub>2</sub>NH Dimethylamine, and H<sub>2</sub>N(CH<sub>2</sub>)<sub>3</sub>Si(OC<sub>2</sub>H<sub>5</sub>)<sub>3</sub> 3-Aminopropyltriethoxysilane.

18. The method of claim 1, further comprising:  
heating said dielectric film on said substrate to a temperature ranging from 50C to 400C.

19. The method of claims 1 or 2, wherein exposing said dielectric film to said C<sub>x</sub>H<sub>y</sub> containing material facilitates at least one of healing said dielectric film, sealing said dielectric film, and cleaning said dielectric film.

20. The method of claim 1, wherein said exposing at least one surface of said dielectric film to said C<sub>x</sub>H<sub>y</sub> containing material comprises exposing said at least one surface of said dielectric film to a first C<sub>x</sub>H<sub>y</sub> containing material, and to a second C<sub>x</sub>H<sub>y</sub> containing material.

21. A method of producing a dielectric film on a substrate comprising:  
forming said dielectric film on said substrate;  
forming a mask on said dielectric film;  
forming a pattern in said mask;  
forming at least one feature in said dielectric film by transferring said pattern in said mask to said dielectric film; and  
exposing a sidewall of said feature in said dielectric film to a treating compound, said treating compound comprises a C<sub>x</sub>H<sub>y</sub> containing material, wherein x and y are each integers greater than or equal to unity.

22. The method of claim 21, further comprising:  
exposing said sidewall of said feature to said treating compound, wherein said treating compound further comprises at least one of a N-containing material and a Cl-containing material.

23. The method of claims 21 or 22, further comprising:  
heating said dielectric film on said substrate to a temperature ranging  
from 50C to 400C.

24. The method of claims 21 or 22, wherein said exposing said sidewall  
of said feature to said C<sub>x</sub>H<sub>y</sub> containing material comprises exposing said  
sidewall of said feature to at least one of a CH<sub>2</sub> containing material, and a CH<sub>3</sub>  
containing material.

25. The method of claim 21, wherein said exposing said sidewall of  
said feature to said C<sub>x</sub>H<sub>y</sub> containing material comprises exposing said sidewall  
of said feature to at least one of TMCTS, and OMCTS.

26. The method of claim 22, wherein said exposing said sidewall of  
said feature in said dielectric film to said healing compound comprises  
exposing said dielectric film to at least one of hexamethyldisilazane (HMDS),  
trimethyldisilazane (TMDS), chlorotrimethylsilane (TMCS),  
trichloromethylsilane (TCMS), [C<sub>6</sub>H<sub>5</sub>Si(CH<sub>3</sub>)<sub>2</sub>]<sub>2</sub>NH, C<sub>15</sub>H<sub>29</sub>NSi, (CH<sub>3</sub>)<sub>2</sub>NH  
Dimethylamine, and H<sub>2</sub>N(CH<sub>2</sub>)<sub>3</sub>Si(OC<sub>2</sub>H<sub>5</sub>)<sub>3</sub> 3-Aminopropyltriethoxysilane.

27. A method of treating a dielectric film comprising  
exposing said dielectric film to a treating compound, said treating  
compound comprises a C<sub>x</sub>H<sub>y</sub> containing material, wherein x and y are each  
integers greater than or equal to unity.

28. The method of claim 27, further comprising:  
exposing said dielectric film to said treating compound, wherein said  
treating compound further comprise at least one of a N-containing material  
and a Cl-containing material.

29. The method of claims 27 or 28, wherein exposing said dielectric  
film to said treating compound facilitates at least one of healing said dielectric  
film, sealing said dielectric film, and cleaning said dielectric film.

30. A treated dielectric film comprising:  
a dielectric film;  
a feature formed in said dielectric film; and  
means for healing a surface of said feature.

31. A sealed dielectric film comprising:  
a porous dielectric film;  
a feature formed in said porous dielectric film; and  
means for sealing exposed pores on a surface of said feature in said  
porous dielectric film.

32. A processing system for treating a dielectric film on a substrate  
comprising:  
a process chamber;  
a fluid distribution system coupled to said process chamber and  
configured to supply a treating compound to said process chamber in order to  
treat said dielectric film on said substrate, said treating compound comprises  
a  $C_xH_y$  containing material, wherein x and y are each integers greater than or  
equal to unity.

33. The system of claim 32, wherein said treating compound further  
comprises at least one of a N-containing material and a Cl-containing  
material.

34. The system of claims 32 or 33, wherein said treating compound  
facilitates at least one of healing said dielectric film, sealing said dielectric film,  
and cleaning said dielectric film.

35. The processing system of claims 32 or 33, wherein said  $C_xH_y$   
containing material comprises at least one of a  $CH_2$  containing material, and a  
 $CH_3$  containing material.

36. The processing system of claim 32, wherein said  $C_xH_y$  containing material comprises at least one of TMCTS, and OMCTS.

37. The processing system of claim 33, wherein said treating compound comprises at least one of hexamethyldisilazane (HMDS), trimethyldisilazane (TMDS), chlorotrimethylsilane (TMCS), trichloromethylsilane (TCMS),  $[C_6H_5Si(CH_3)_2]_2NH$ ,  $C_{15}H_{29}NSi$ ,  $(CH_3)_2NH$  Dimethylamine, and  $H_2N(CH_2)_3Si(OC_2H_5)_3$  3-Aminopropyltriethoxysilane.

38. The processing system of claim 32, wherein said process chamber further comprises a substrate holder configured to support said substrate.

39. The processing system of claim 38, wherein said substrate holder is further configured to heat said substrate to a temperature ranging from 50C to 400C.

40. The processing system of claim 32, wherein said process chamber comprises a supercritical processing chamber, and said fluid distribution system is configured to supply said process chamber with a supercritical fluid and said treating compound.

41. The processing system of claim 32, wherein said process chamber comprises a vapor treatment processing chamber, and said fluid distribution system is configured to supply a vapor of said treating compound to said process chamber.

42. The processing system of claim 32, wherein said process chamber comprises an immersion bath, and said fluid distribution system is configured to supply a liquefied treating compound to said process chamber.

43. The processing system of claim 32, wherein said process chamber comprises a liquid-phase treatment system, and said fluid distribution system is configured to dispense said treating compound on said dielectric film.

44. The processing system of claim 38, wherein said liquid-phase treatment system comprises a substrate holder configured to support and rotate said substrate with said dielectric film during said dispensing of said treating compound.

45. A processing system for treating a dielectric film on a substrate comprising:

means for exposing said dielectric film to a treating compound, said treating compound comprising a  $C_xH_y$  containing material, wherein x and y are each integers greater than or equal to unity.

46. The processing system of claim 45, wherein said treating compound further comprises at least one of a N-containing material and a Cl-containing material.

47. The processing system of claim 45, further comprising:

means for heating said dielectric film on said substrate to a temperature ranging from 50C to 200C.

48. A treated dielectric film comprising:

a dielectric film having a surface region; and

a  $C_xH_y$  containing material located in said surface region of the low-k film.